

U.S. Patent Application No. 10/042,549
Amendment dated August 28, 2003
Reply to Office Action of April 28, 2003

Amendments to the Claims:

This listing of claims will replace all prior versions, and listings, of claims in the application:

Listing of Claims:

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Claim 1 (currently amended): A tantalum billet having a substantially uniform grain size, wherein said tantalum billet is ingot-derived and having a purity of at least about 99.99%.

Claim 2 (currently amended): An extruded tantalum billet having a substantially uniform average grain size, wherein said tantalum billet is ingot-derived and having a purity of at least about 99.99%.

Claim 3 (Original): The extruded tantalum billet of claim 2, wherein said average grain size is about 150 microns or less.

Claim 4 (Original): The extruded tantalum billet of claim 2, wherein said average grain size is about 100 microns or less.

Claim 5 (Original): The extruded tantalum billet of claim 2, wherein said average grain size is about 50 microns or less.

Claim 6 (Original): The extruded tantalum billet of claim 2, wherein said average grain size is from about 25 microns to about 100 microns.

Claim 7 (Original): The extruded tantalum billet of claim 2, having a purity of at least about 99.995%.

Claim 8 (Original): The extruded tantalum billet of claim 2, wherein said tantalum billet is fully recrystallized.

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Claim 9 (Original): The extruded tantalum billet of claim 2, wherein said tantalum billet is at least partially recrystallized.

Claim 10 (Original): The extruded tantalum billet of claim 2, wherein said tantalum billet is about 98% or more recrystallized.

Claim 11 (Original): The extruded tantalum billet of claim 2, wherein said tantalum billet is about 80% or more recrystallized.

Claim 12 (Original): The extruded tantalum billet of claim 2, having a purity of from about 99.995% to about 99.999%

Claim 13 (Original): The extruded tantalum billet of claim 2, further comprising at least one alloy material.

Claim 14 (Original): A sputtering target comprising the extruded tantalum billet of claim 2.

Claim 15 (Original): A capacitor can comprising the extruded tantalum billet of claim 2.

Claim 16 (Original): A resistive film layer comprising the extruded tantalum billet of claim 2.

Claim 17 (Original): An article comprising at least as a component the extruded tantalum billet of claim 2.

Claim 18 (Original): A process for making the extruded tantalum billet of claim 2 comprising extruding a tantalum ingot at a sufficient temperature and for a sufficient time to at least partially recrystallize the tantalum billet during extrusion.

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Claim 19 (Original): The process of claim 18, wherein said sufficient temperature is from about 1200 °F to about 2950 °F.

Claim 20 (Original): The process of claim 18, wherein said temperature is uniform throughout the extrusion process.

Claim 21 (Original): The process of claim 18, further comprising the step of water quenching the extruded tantalum billet after extrusion.

Claim 22 (Original): The process of claim 18, further comprising machine cleaning the extruded tantalum billet.

Claim 23 (Original): A process for making the extruded tantalum billet of claim 2, comprising extruding a starting tantalum billet at a sufficient temperature and for a sufficient time to at least partially recrystallize the tantalum billet to form said extruded tantalum billet.

Claim 24 (Original): The process of claim 23, wherein said sufficient temperature is from about 1200 °F to about 2950 °F.

Claim 25 (Original): The process of claim 23, wherein said temperature is uniform throughout the extrusion process.

Claim 26 (Original): The process of claim 23, further comprising the step of water quenching the extruded tantalum billet after extrusion.

Claim 27 (Original): The process of claim 23, further comprising machine cleaning the extruded tantalum billet.

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Claim 28 (Original): A process for making the extruded tantalum billet of claim 2, comprising cutting an ingot into at least one starting billet and either applying a protective coating on said starting billet or placing said starting billet in a can;

extruding the starting billet at a sufficient temperature and for a sufficient time to at least partially recrystallize the tantalum billet and to form said extruded tantalum billet.

Claim 29 (Original): The process of claim 28, wherein said sufficient temperature is from about 1200 °F to about 2950 °F.

Claim 30 (Original): The process of claim 28, wherein said temperature is uniform throughout the extrusion process.

Claim 31 (Original): The process of claim 28, further comprising the step of water quenching the extruded tantalum billet after extrusion.

Claim 32 (Original): The process of claim 28, further comprising machine cleaning the extruded tantalum billet.

Claim 33 (Original): The process of claim 28, wherein said ingot is obtained by the electron beam melting of a high purity tantalum powder feedstock.

Claim 34 (Original): The process of claim 28, wherein said protective coating or can is removed after said extruding.

Claim 35 (Original): The process of claim 34, wherein said protective coating is removed by acid washing or machine cleaning, or both.

Claim 36 (currently amended): A niobium billet having a substantially uniform grain size, wherein said tantalum billet is ingot-derived and having a purity of at least about 99.99%.

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Claim 37 (currently amended): An extruded niobium billet having a substantially uniform average grain size, wherein said tantalum billet is ingot-derived and having a purity of at least about 99.99%.

Claim 38 (Original): The extruded niobium billet of claim 37, wherein said average grain size is about 150 microns or less.

Claim 39 (Original): The extruded niobium billet of claim 37, wherein said average grain size is about 100 microns or less.

Claim 40 (Original): The extruded niobium billet of claim 37, wherein said average grain size is about 50 microns or less.

Claim 41 (Original): The extruded niobium billet of claim 37, wherein said average grain size is from about 25 microns to about 100 microns.

Claim 42 (Original): The extruded niobium billet of claim 37, having a purity of at least about 99.995%.

Claim 43 (Original): The extruded niobium billet of claim 37, wherein said niobium billet is fully recrystallized.

Claim 44 (Original): The extruded niobium billet of claim 37, wherein said niobium billet is at least partially recrystallized.

Claim 45 (Original): The extruded niobium billet of claim 37, wherein said niobium billet is about 98% or more recrystallized.

Claim 46 (Original): The extruded niobium billet of claim 37, wherein said niobium billet is about 80% or more recrystallized.



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Claim 47 (Original): The extruded niobium billet of claim 37, having a purity of from about 99.995% to about 99.999%

Claim 48 (Original): The extruded niobium billet of claim 37, further comprising at least one alloy material.

Claim 49 (Original): A sputtering target comprising the extruded niobium billet of claim 37.

Claim 50 (Original): A capacitor can comprising the extruded niobium billet of claim 37.

Claim 51 (Original): A resistive film layer comprising the extruded niobium billet of claim 37.

Claim 52 (Original): An article comprising at least as a component the extruded niobium billet of claim 37.

Claim 53 (Original): A process for making the extruded niobium billet of claim 37 comprising extruding a niobium ingot at a sufficient temperature and for a sufficient time to at least partially recrystallize the niobium billet during extrusion.

Claim 54 (Original): The process of claim 53, wherein said sufficient temperature is from about 1000 °F to about 2650 °F.

Claim 55 (Original): The process of claim 53, wherein said temperature is uniform throughout the extrusion process.

Claim 56 (Original): The process of claim 53, further comprising the step of water quenching the extruded niobium billet after extrusion.

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Claim 57 (Original): The process of claim 53, further comprising machine cleaning the extruded niobium billet.

Claim 58 (Original): A process for making the extruded niobium billet of claim 37, comprising extruding a starting niobium billet at a sufficient temperature and for a sufficient time to at least partially recrystallize the niobium billet to form said extruded niobium billet.

Claim 59 (Original): The process of claim 58, wherein said sufficient temperature is from about 1000 °F to about 2650 °F.

Claim 60 (Original): The process of claim 58, wherein said temperature is uniform throughout the extrusion process.

Claim 61 (Original): The process of claim 58, further comprising the step of water quenching the extruded niobium billet after extrusion.

Claim 62 (Original): The process of claim 58, further comprising machine cleaning the extruded niobium billet.

Claim 63 (Original): A process for making the extruded niobium billet of claim 37, comprising cutting an ingot into at least one starting billet and either applying a protective coating on said starting billet or placing said starting billet in a can;

extruding the starting billet at a sufficient temperature and for a sufficient time to at least partially recrystallize the niobium billet and to form said extruded niobium billet.

Claim 64 (Currently Amended): The process of claim 63, wherein said sufficient temperature is from about 1000 °F to about 2650 °F °C.

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Claim 65 (Original): The process of claim 63, wherein said temperature is uniform throughout the extrusion process.

Claim 66 (Original): The process of claim 63, further comprising the step of water quenching the extruded niobium billet after extrusion.

Claim 67 (Original): The process of claim 63, further comprising machine cleaning the extruded niobium billet.

Claim 68 (Original): The process of claim 63, wherein said ingot is obtained by the electron beam melting of a high purity niobium powder feedstock.

Claim 69 (Original): The process of claim 63, wherein said protective coating or can is removed after said extruding.

Claim 70 (Original): The process of claim 69, wherein said protective coating is removed by acid washing or machine cleaning, or both.

Claim 71 (Original): The process of claim 18, further comprising annealing said extruded tantalum billet.

Claim 72 (Original): The process of claim 71, wherein said annealing occurs at a temperature and for a time sufficient to at least partially recrystallize the extruded tantalum billet during annealing.

Claim 73 (Currently Amended): The process of claim 71, wherein said annealing occurs at a temperature of from about 1742°F 950°C to about 2102°F 1150°C for about 2 hours.

Claim 74 (Original): The process of claim 23, further comprising annealing said extruded tantalum billet.

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Claim 75 (Original): The process of claim 74, wherein said annealing occurs at a temperature and for a time sufficient to at least partially recrystallize the extruded tantalum billet during annealing.

Claim 76 (Currently Amended): The process of claim 74, wherein said annealing occurs at a temperature of from about 1742°F ~~950°C~~ to about 2102°F ~~1150°C~~ for about 2 hours.

Claim 77 (Original): The process of claim 28, further comprising annealing said extruded tantalum billet.

Claim 78 (Original): The process of claim 77, wherein said annealing occurs at a temperature and for a time sufficient to at least partially recrystallize the extruded tantalum billet during annealing.

Claim 79 (Currently Amended): The process of claim 77, wherein said annealing occurs at a temperature of from about 1742°F ~~950°C~~ to about 2102°F ~~1150°C~~ for about 2 hours.

Claim 80 (Original): The process of claim 53, further comprising annealing said extruded niobium billet.

Claim 81 (Original): The process of claim 80, wherein said annealing occurs at a temperature and for a time sufficient to at least partially recrystallize the extruded niobium billet during annealing.

Claim 82 (Currently Amended): The process of claim 80, wherein said annealing occurs at a temperature of from about 1742°F ~~950°C~~ to about 2102°F ~~1150°C~~ for about 2 hours.

Claim 83 (Original): The process of claim 58, further comprising annealing said extruded niobium billet.

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Claim 84 (Original): The process of claim 83, wherein said annealing occurs at a temperature and for a time sufficient to at least partially recrystallize the extruded niobium billet during annealing.

Claim 85 (Currently Amended): The process of claim 83, wherein said annealing occurs at a temperature of from about 1742°F ~~950°C~~ to about 2102°F ~~1150°C~~ for about 2 hours.

Claim 86 (Original): The process of claim 63, further comprising annealing said extruded niobium billet.

Claim 87 (Original): The process of claim 86, wherein said annealing occurs at a temperature and for a time sufficient to at least partially recrystallize the extruded niobium billet during annealing.

Claim 88 (Currently Amended): The process of claim 86, wherein said annealing occurs at a temperature of from about 1742°F ~~950°C~~ to about 2102°F ~~1150°C~~ for about 2 hours.

Claim 89 (Original): A process for making the extruded tantalum billet of claim 2, comprising extruding a tantalum ingot to form an extruded tantalum billet and then annealing said extruded tantalum billet at a sufficient temperature and for a sufficient time to at least partially recrystallize the extruded tantalum billet.

Claim 90 (Original): A process for making the extruded tantalum billet of claim 2, comprising extruding a starting tantalum billet to form said extruded tantalum billet and then annealing said extruded tantalum billet for a sufficient time and for a sufficient temperature to at least partially recrystallize the extruded tantalum billet.

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Claim 91 (Original): A process for making the extruded tantalum billet of claim 2, comprising cutting an ingot into at least one starting billet and either applying a protective coating on said starting billet or placing said starting billet in a can;

extruding the starting billet to form said extruded tantalum billet and then annealing said extruded tantalum billet at a sufficient temperature and for a sufficient time to at least partially recrystallize the extruded tantalum billet.

Claim 92 (Original): A process for making the extruded niobium billet of claim 37, comprising extruding a niobium ingot to form an extruded niobium billet and then annealing said extruded niobium billet at a sufficient temperature and for a sufficient time to at least partially recrystallize the extruded niobium billet.

Claim 93 (Original): A process for making the extruded niobium billet of claim 37, comprising extruding a starting niobium billet to form said extruded niobium billet and then annealing said extruded niobium billet for a sufficient time and for a sufficient temperature to at least partially recrystallize the extruded niobium billet.

Claim 94 (Original): A process for making the extruded niobium billet of claim 37, comprising cutting an ingot into at least one starting billet and either applying a protective coating on said starting billet or placing said starting billet in a can;

extruding the starting billet to form said extruded niobium billet and then annealing said extruded niobium billet at a sufficient temperature and for a sufficient time to at least partially recrystallize the extruded niobium billet.